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(54) **PATTERNED VACUUM CHUCK FOR DOUBLE-SIDED PROCESSING**

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(52) **U.S. Cl.**

CPC ***H01L 21/6838*** (2013.01); *G03F 7/707* (2013.01); *H01L 21/6875* (2013.01)

(58) **Field of Classification Search**

CPC . H01L 21/6838; H01L 21/6875; G03F 7/707; Y10T 279/11

See application file for complete search history.

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(57) **ABSTRACT**

Embodiments described herein relate to a substrate chucking apparatus having a plurality of cavities formed therein. The cavities are formed in a body of the chucking apparatus. In one embodiment, a first plurality of ports are formed in a chucking surface of the body and extend to a bottom surface of the body. In another embodiment, a second plurality of ports are formed in a bottom surface of the plurality of cavities and extend through the body to a bottom surface of the body.

20 Claims, 8 Drawing Sheets

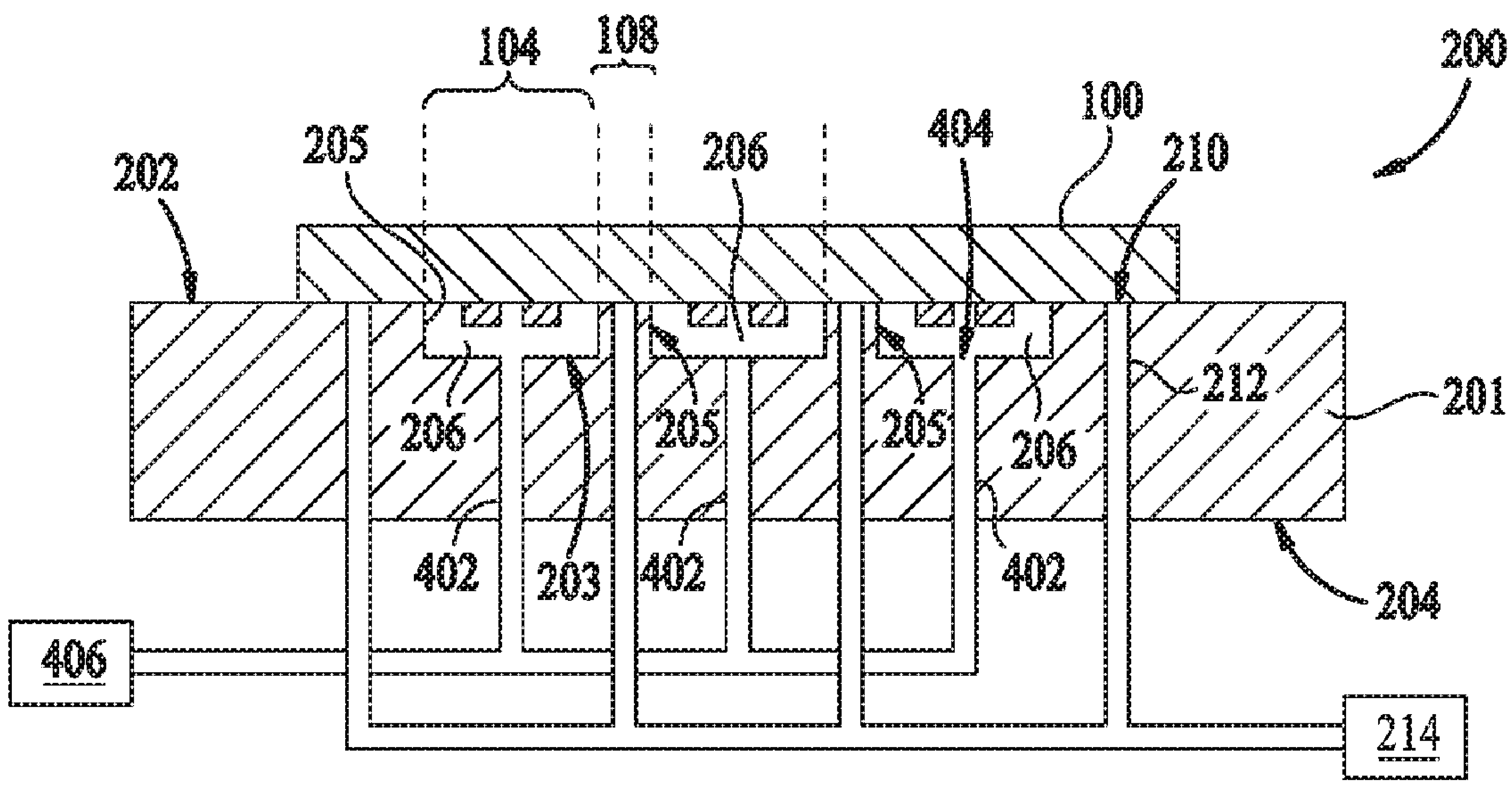

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FIG. 1A

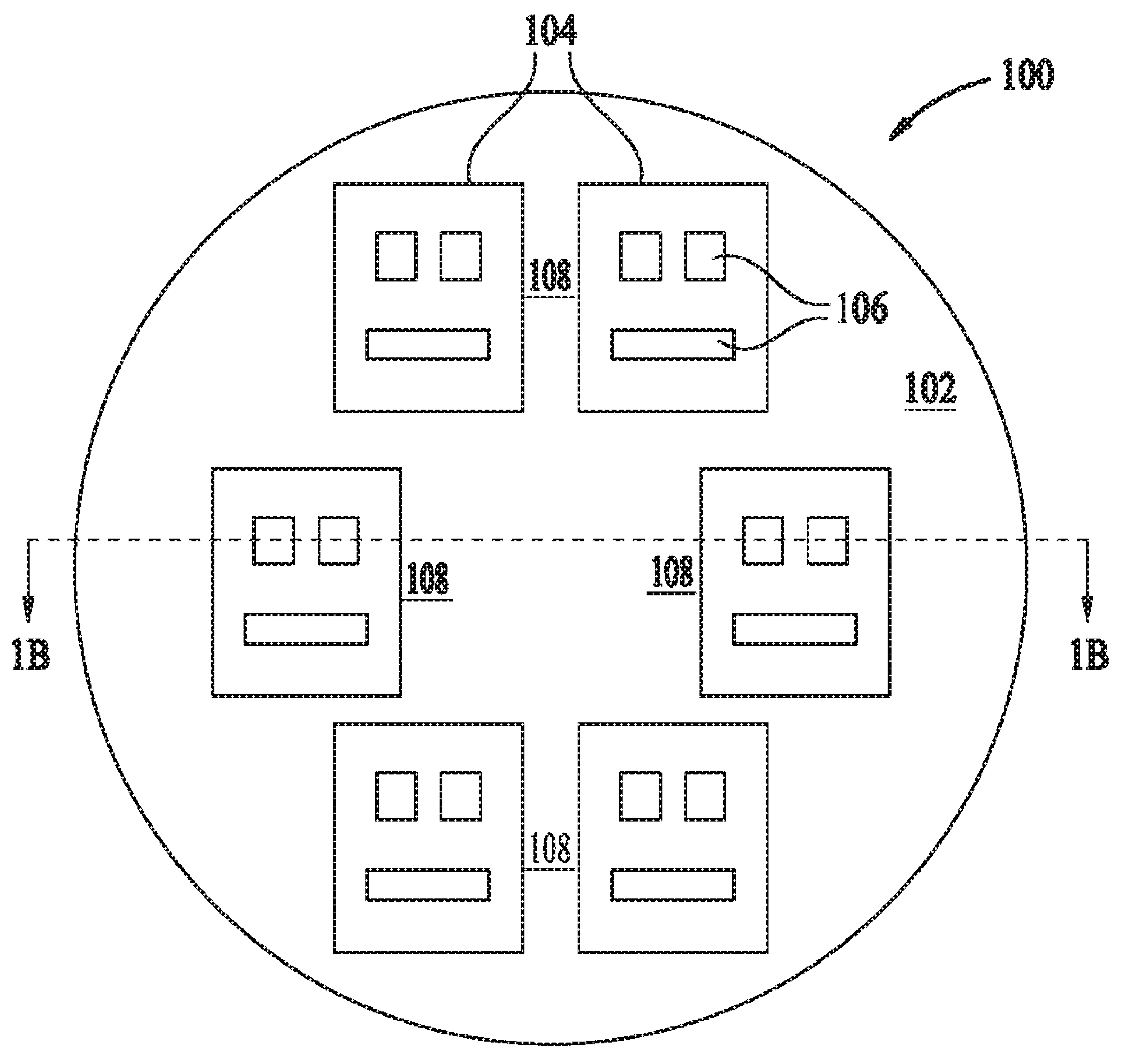

104
100
108
106
102
108
108
1B
1B
108

FIG. 1B

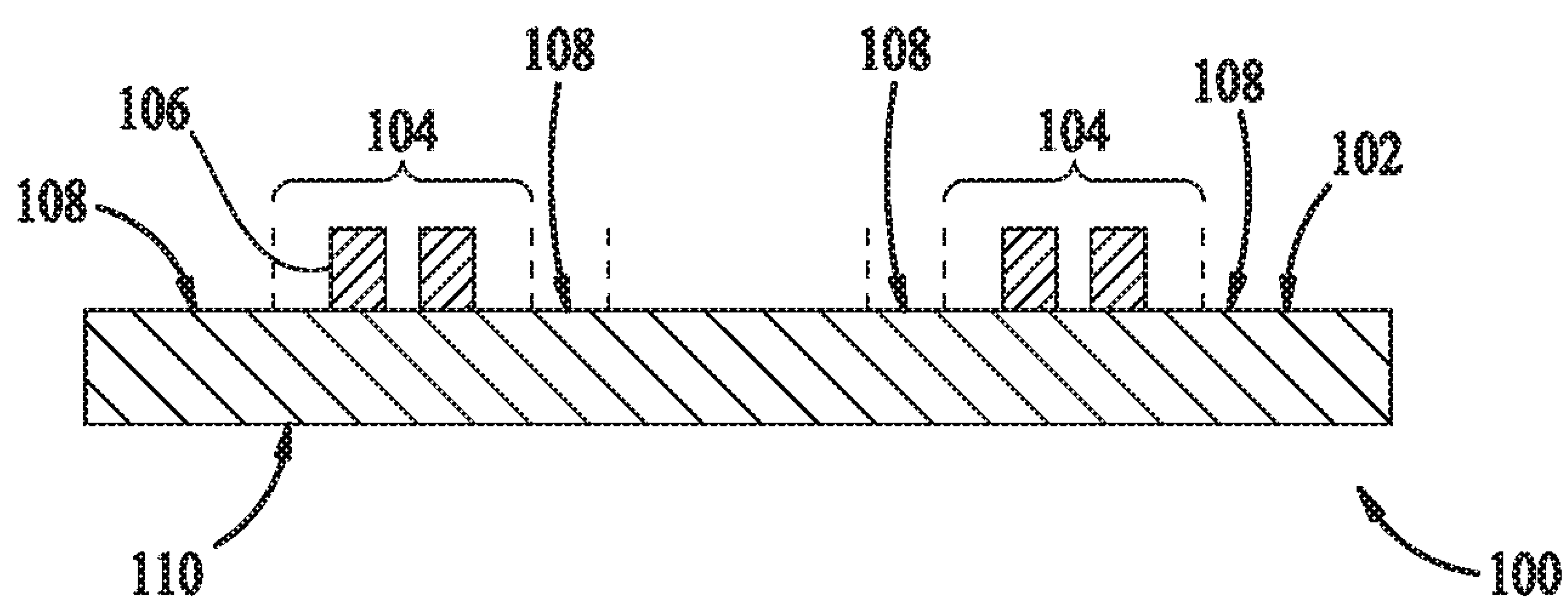

106
104
108
108
108
104
102
108
110
100

FIG. 2A

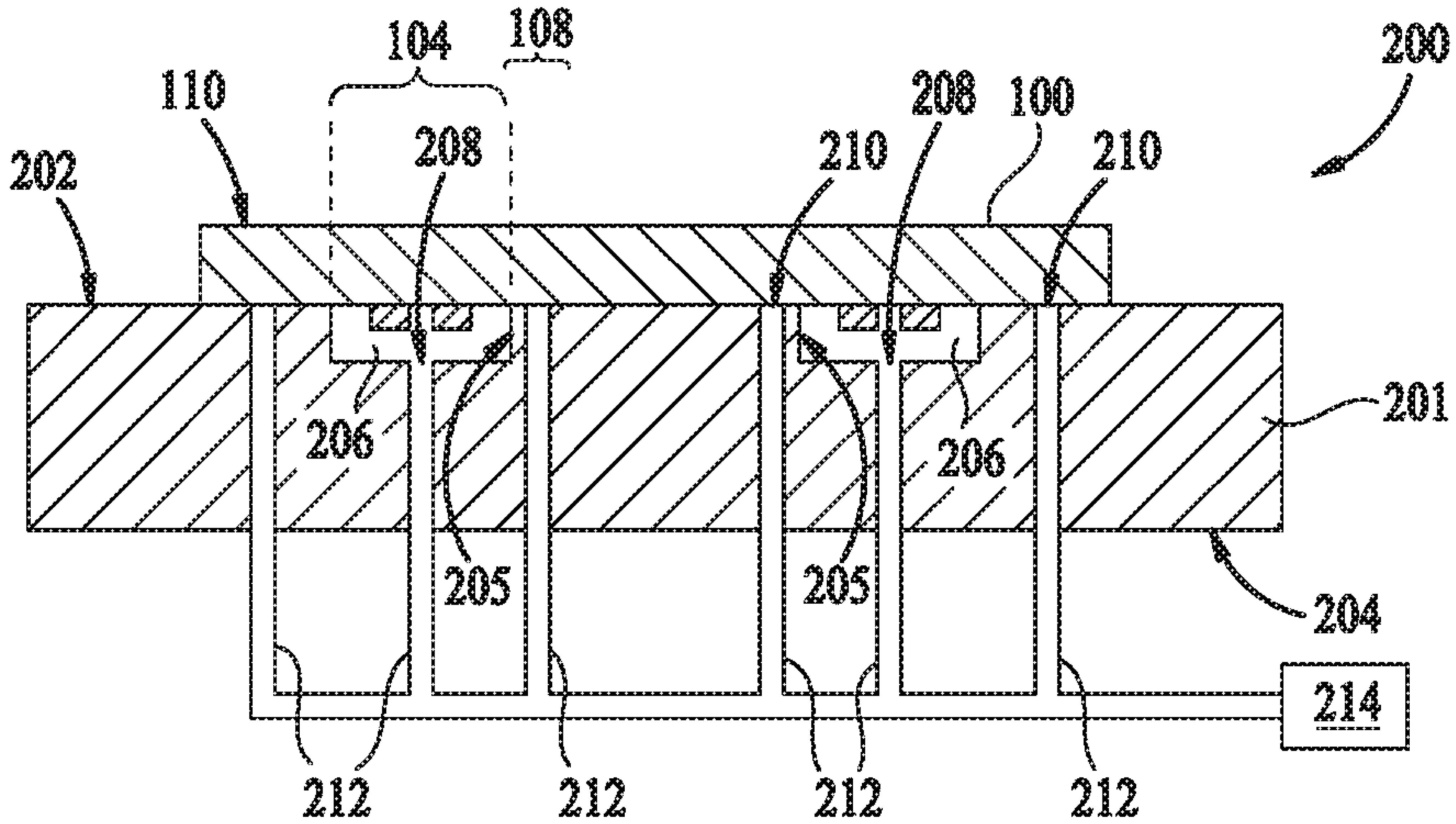

104
108
110
202
208
210
208
100
210
200
206
205
205
206
201
204
214
212
212
212
212

FIG. 2B

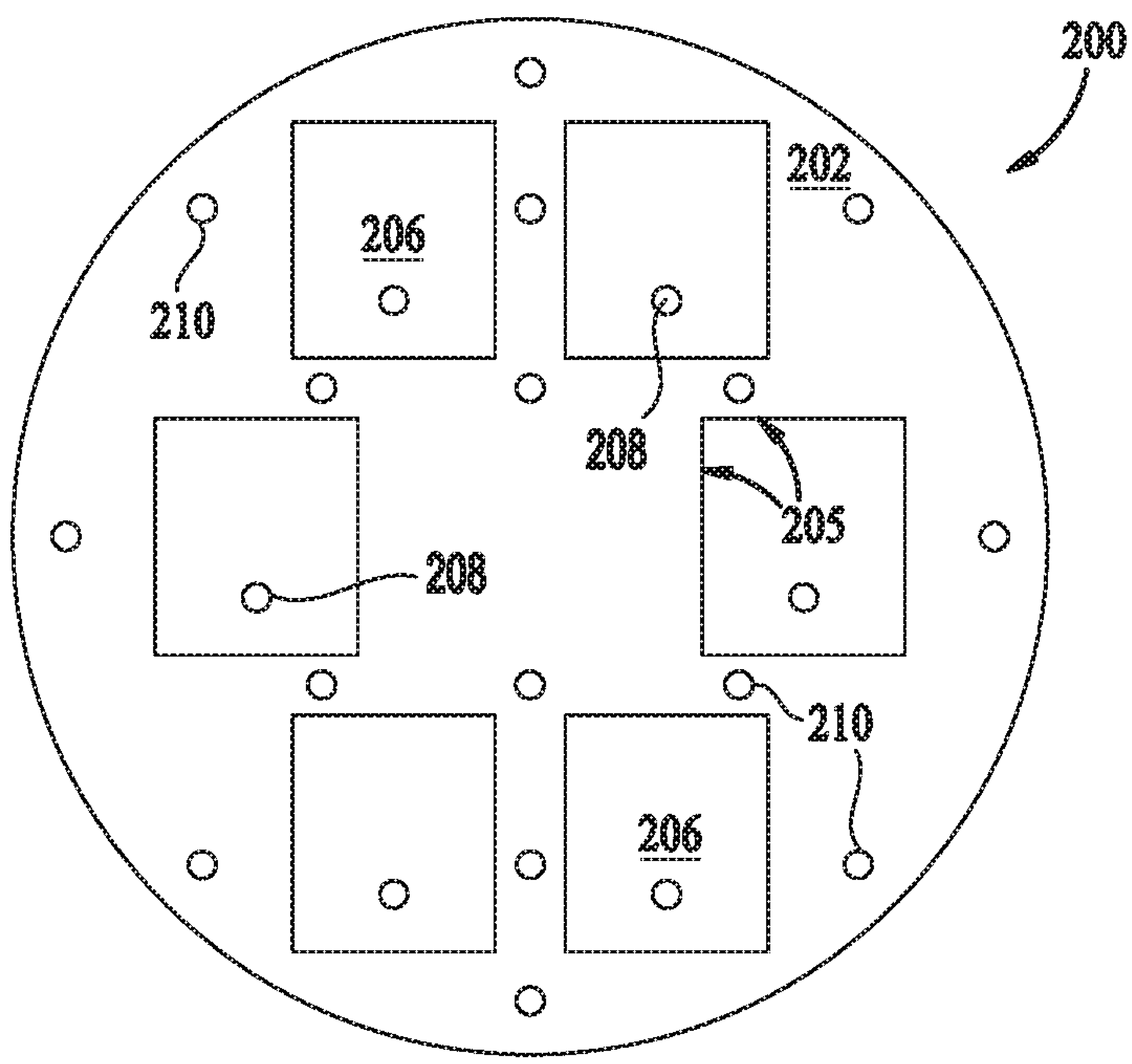
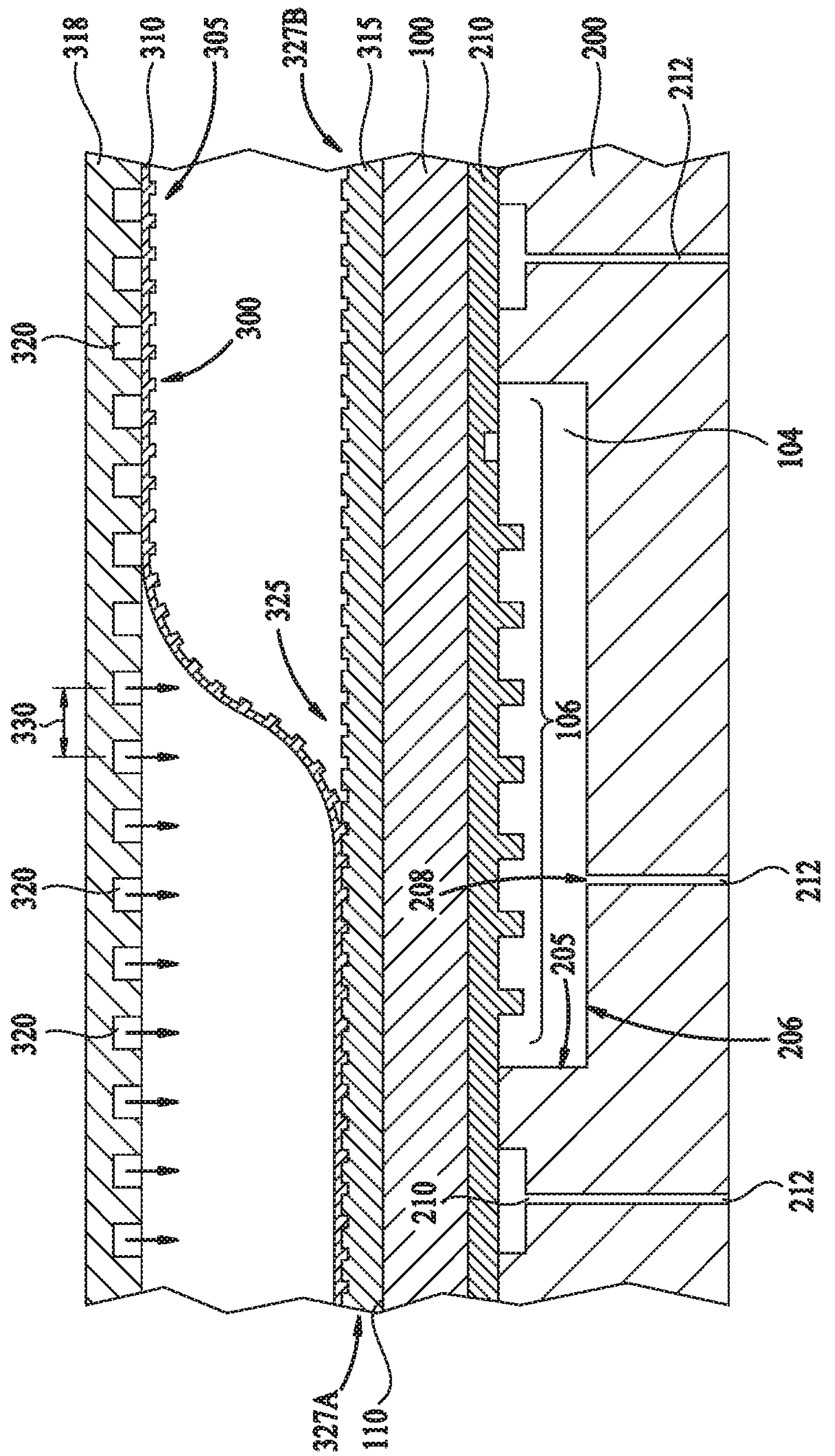

200
206
202
210
208
208
205
210
206

FIG. 3A


318
310
305
327B
315
100
210
200
212
320
300
104
325
330
106
208
205
206
327A
110

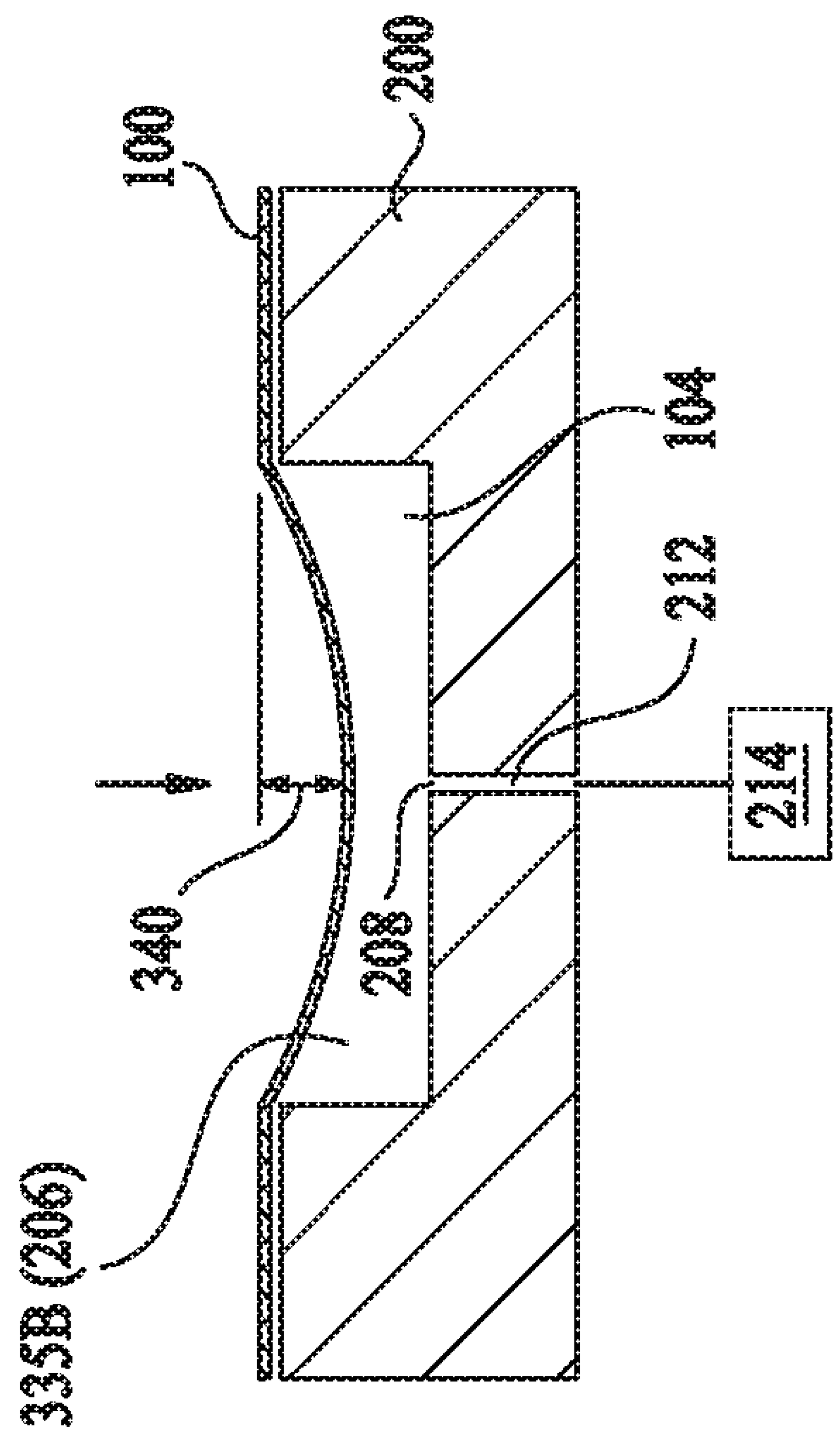

100
200
104
212
214
340
208
335B (206)

FIG. 3C

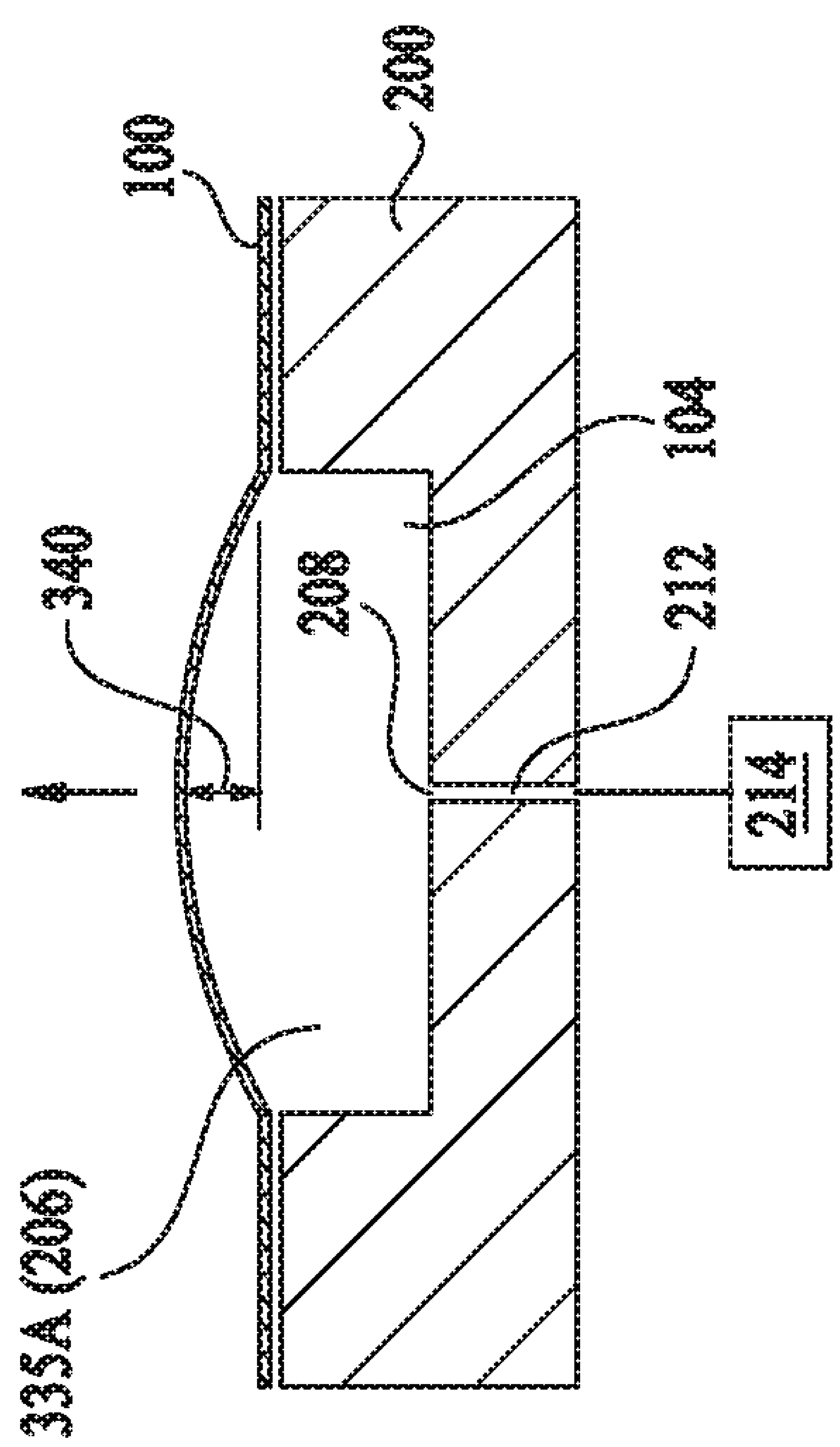

100
200
104
340
208
212
214
335A (206)

FIG. 3B

FIG. 4A

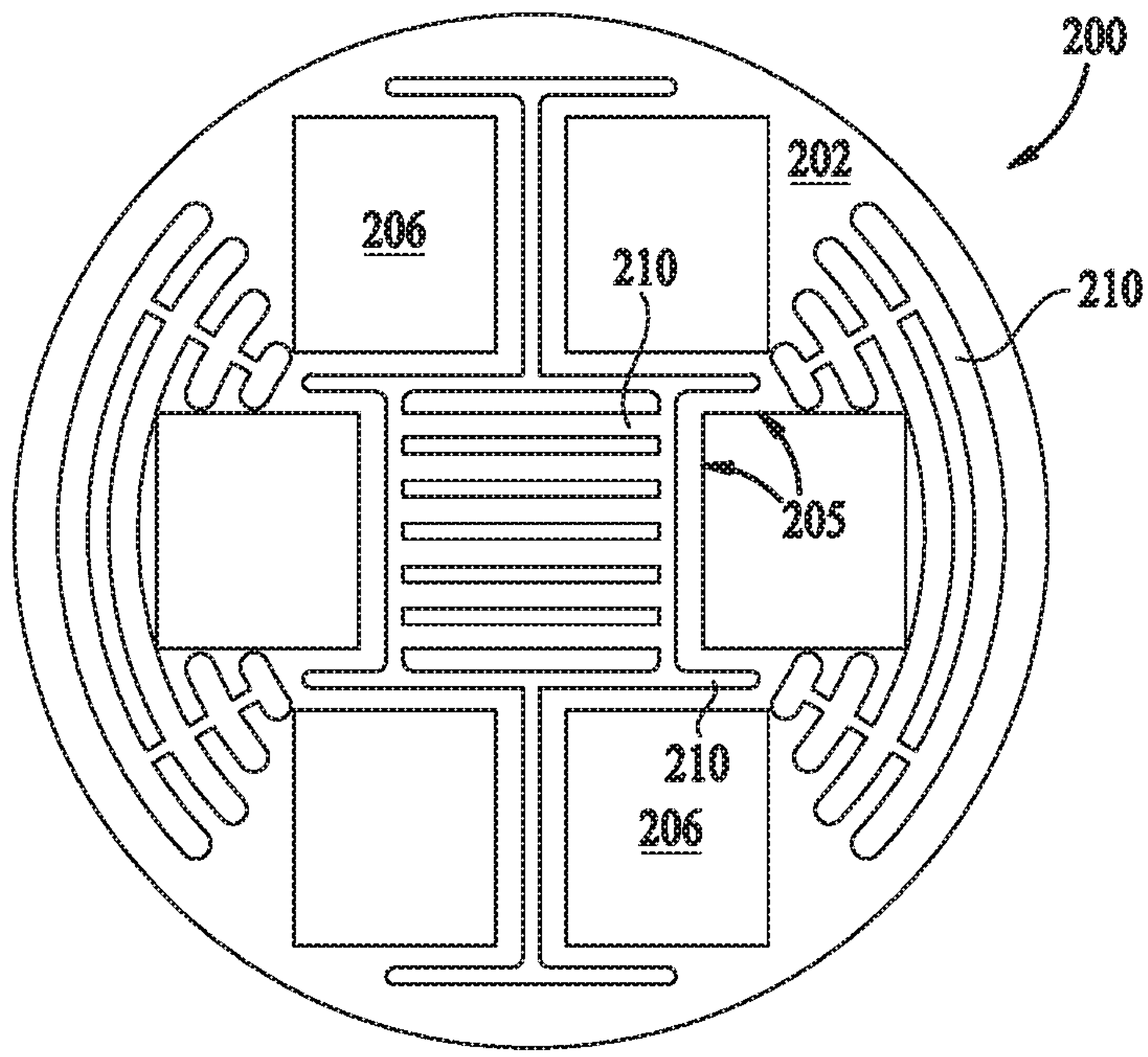

200
202
206
210
210
205
210
206

FIG. 4B

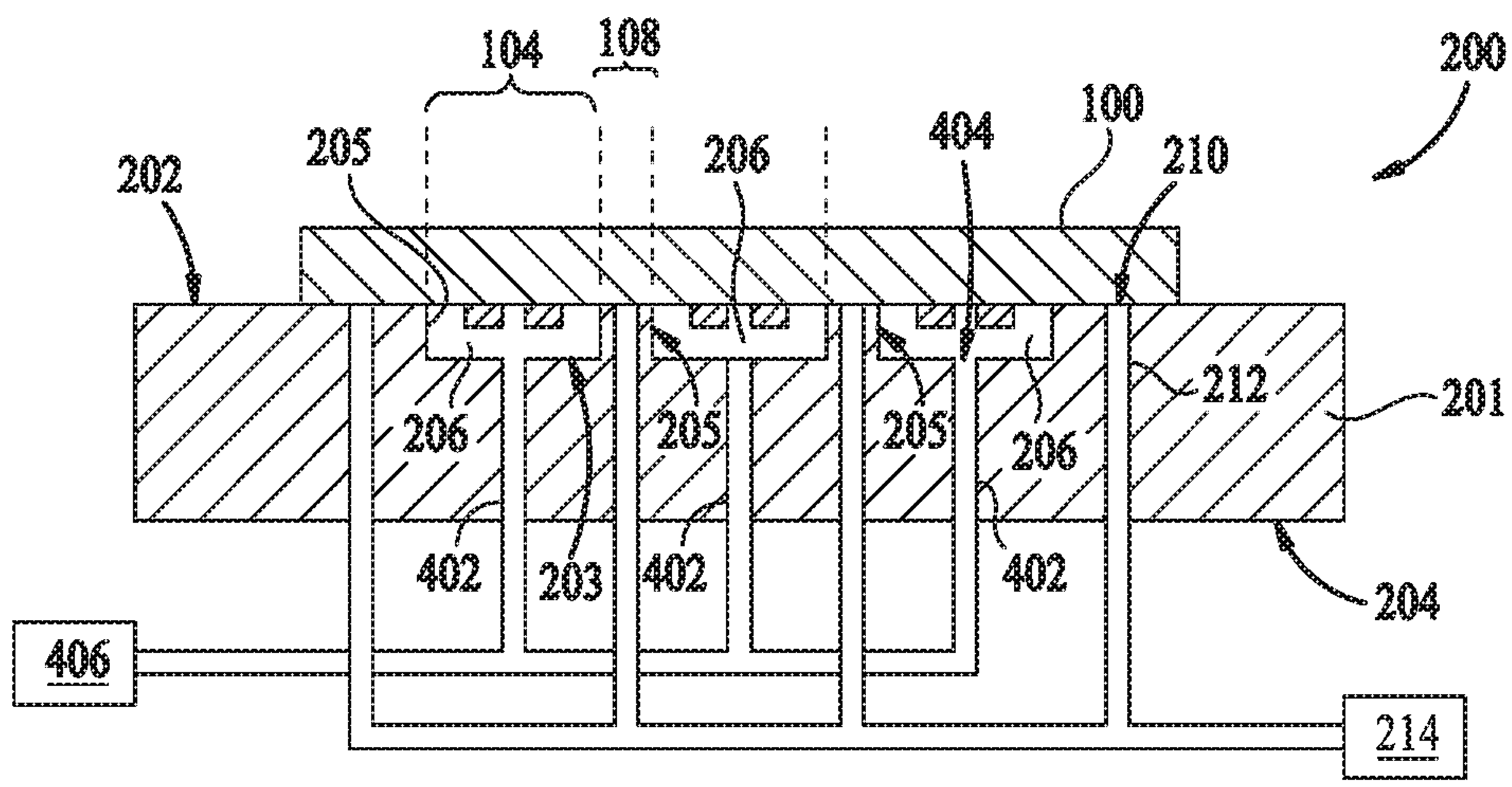

104
108
200
202
205
206
404
100
210
212
201
206
205
205
206
402
203
402
402
204
406
214

FIG. 5A

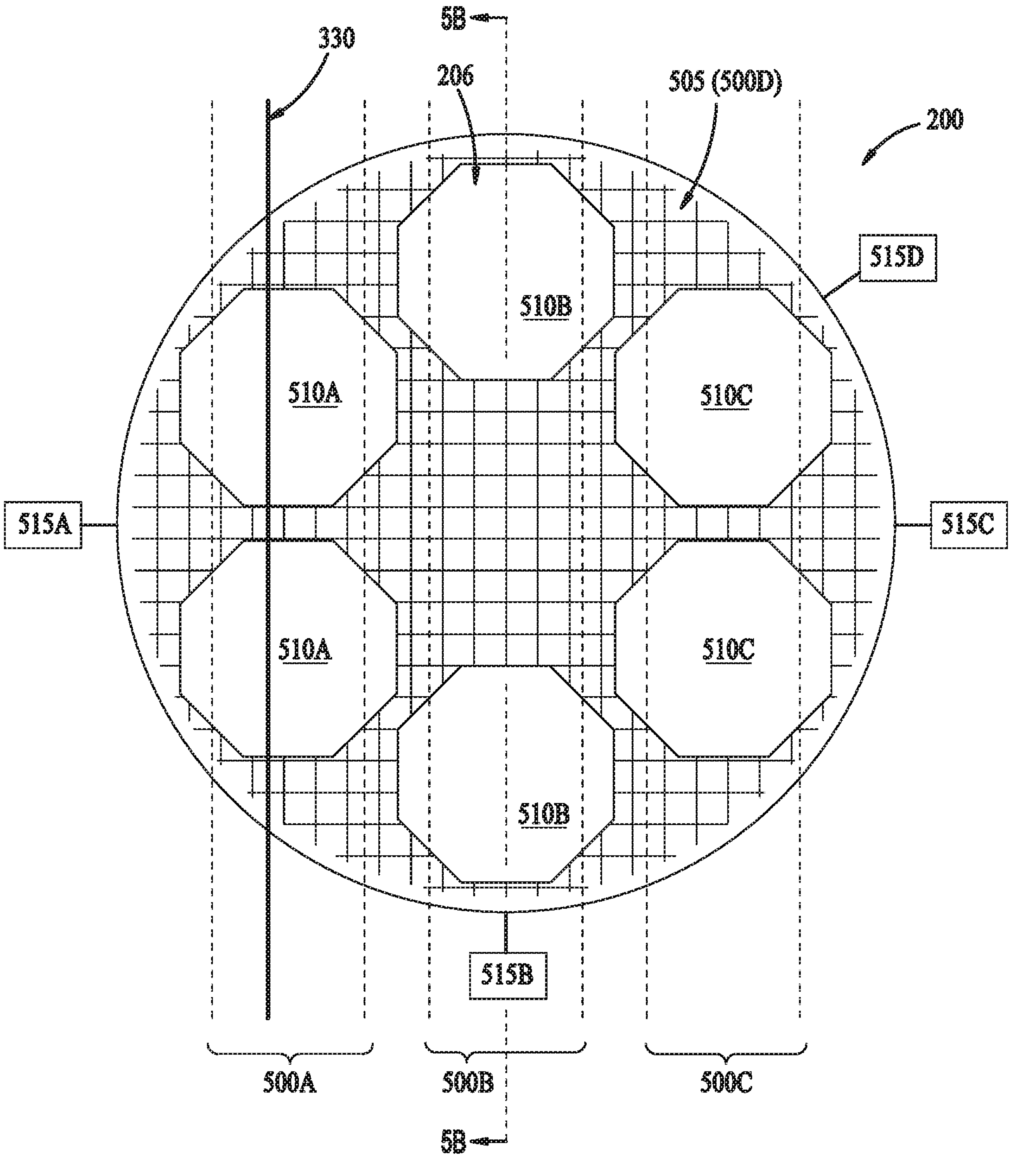
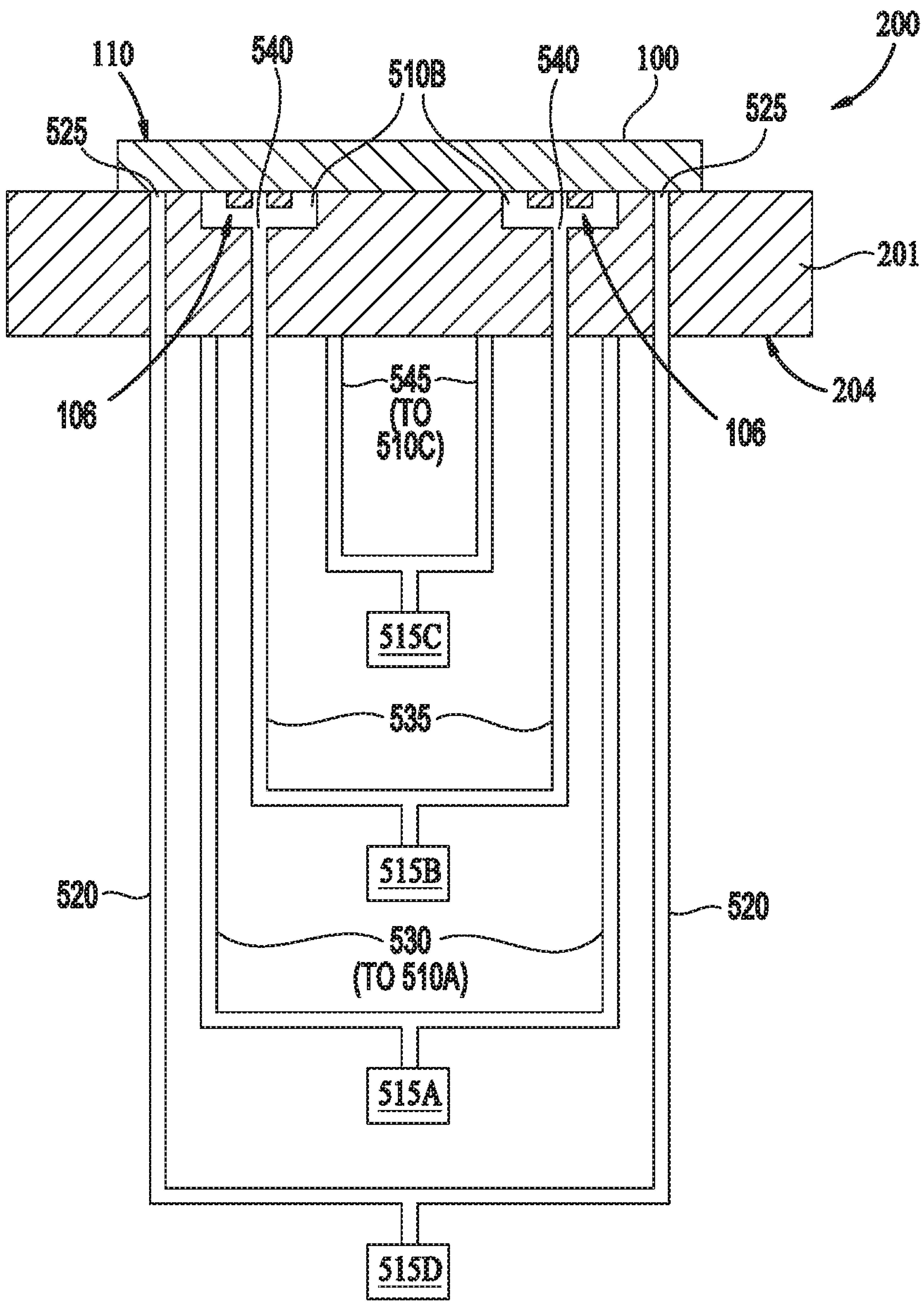

5B
330
206
505 (500D)
200
515D
510B
510A
510C
515A
515C
510A
510C
510B
515B
500A
500B
500C
5B

FIG. 5B


200
110
540
510B
540
100
525
525
201
204
106
545
(TO
510C)
106
515C
535
515B
520
520
530
(TO 510A)
515A
515D

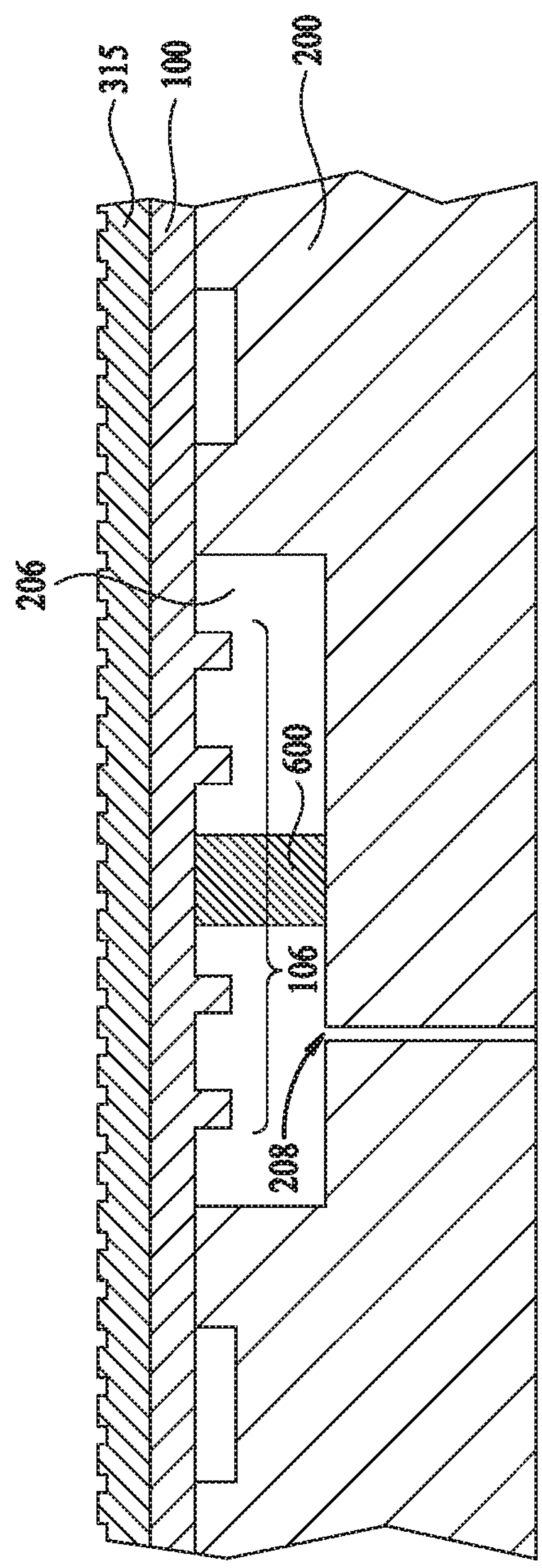


FIG. 6

PATTERNED VACUUM CHUCK FOR DOUBLE-SIDED PROCESSING

CROSS-REFERENCE TO RELATED APPLICATION

This application is a divisional of U.S. patent application Ser. No. 16/260,675, filed Jan. 29, 2019, which claims benefit of U.S. Provisional Patent Application Ser. No. 62/632,867, filed Feb. 20, 2018, both of which are hereby incorporated by reference herein.

BACKGROUND

Field

Embodiments of the present disclosure generally relate to a substrate chuck. More specifically, embodiments described herein relate to a patterned vacuum chuck.

Description of the Related Art

Substrate chucking apparatus are commonly used in the semiconductor and display industries to support a substrate during transfer or processing of the substrate. Emerging technologies have lead to the development of various advanced processing techniques for device and structure fabrication on substrates. For example, fabrication of a waveguide apparatus for virtual reality and augmented reality applications has pushed the boundaries of conventional substrate processing techniques.

Waveguide apparatus incorporate microstructures formed on a glass or glass-like substrate. Often, microstructures are formed on a front side of the substrate and a backside of the substrate. However, handling and supporting a substrate with microstructures formed on the front and back of the substrate during processing is challenging. For example, conventional chucking apparatus may damage microstructures formed on a backside of the substrate while the front side is being processed, or vice versa.

Thus, what is needed in the art are improved chucking apparatus.

SUMMARY

Embodiments described herein relate to a substrate chucking apparatus and method of chucking a substrate. In one embodiment, the substrate chucking apparatus includes a body having a chucking surface and a bottom surface opposite the chucking surface. The body includes a plurality of cavities formed therein that are recessed from the chucking surface, wherein pairs of the plurality of cavities are in fluid communication with a plurality of first conduits. The apparatus also includes a plurality of second conduits formed in the body, one of the plurality of second conduits formed between a portion of the plurality of cavities, wherein a pressure in pairs of the cavities is individually controlled.

In another embodiment, a substrate chucking apparatus includes a circular body having a chucking surface, a plurality of cavities formed in the chucking surface, a plurality of first conduits, each of the plurality of first conduits coupled to a surface port formed in the chucking surface, a second conduit coupled to a first pair of the plurality of cavities, a third conduit coupled to a second pair of the plurality of cavities, and a fourth conduit coupled to a third pair of the plurality of cavities, wherein a pressure in each of the pairs of the cavities is individually controlled

In another embodiment, a method for processing a substrate is described that includes forming a plurality of structures on a first major surface of the substrate, positioning the first major surface on a chuck, wherein each of the plurality of structures are positioned in a respective cavity formed in a chucking surface of the chuck, and applying a first pressure to the major surface through a plurality of surface ports while applying a second pressure in pairs of the cavities, the first pressure being different than the second pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only exemplary embodiments and are therefore not to be considered limiting of its scope, may admit to other equally effective embodiments.

FIG. **1**A illustrates a plan view of a substrate with dies having microstructures formed thereon according to an embodiment described herein.

FIG. **1**B illustrates a cross-sectional view of the substrate of FIG. **1**A taken along line **1**B-**1**B according to an embodiment described herein.

FIG. **2**A illustrates a cross-section view of a vacuum chucking apparatus according to an embodiment described herein.

FIG. **2**B is a plan view of the vacuum chucking apparatus of FIG. **2**A.

FIG. **3**A is a schematic sectional view of a portion of a transfer process of a patterned template onto a substrate.

FIGS. **3**B and **3**C are sectional view of portions of the vacuum chucking apparatus having a substrate thereon.

FIG. **4**A illustrates a plan view of the vacuum chucking apparatus of FIG. **2** according to an embodiment described herein.

FIG. **4**B illustrates a cross-sectional view of the vacuum chucking apparatus of FIG. **4**A.

FIG. **5**A illustrates a plan view of the vacuum chucking apparatus of FIG. **2** according to an embodiment described herein.

FIG. **5**B is a schematic sectional view of the vacuum chucking apparatus along lines **5**B-**5**B of FIG. **5**A.

FIG. **6** illustrates a sectional view of a portion of a vacuum chucking apparatus according to an embodiment described herein.

To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures. It is contemplated that elements and features of one embodiment may be beneficially incorporated in other embodiments without further recitation.

DETAILED DESCRIPTION

Embodiments described herein relate to a substrate chucking apparatus having a plurality of cavities formed therein. A portion of the cavities are utilized to receive a microstructure previously formed on one major side of a substrate which is chucked to the cucking apparatus, and enabling formation of microstructures on another major side of the substrate. The chucking apparatus may be particularly useful in lithography processes, for example, nanoimprint lithography (NIL) processes, such as substrate conformal imprint lithography (SCIL). While some embodiments are exemplarily described for use with an SCIL process, the disclosure is not limited to the SCIL process and may be utilized with other NIL processes. Other NIL processes include using a roller that contacts a flexible template for transferring a pattern to a substrate.

FIG. 1A illustrates a plan view of a substrate **100** with dies having microstructures **106** formed thereon according to a lithography process. In one embodiment, the substrate **100** is formed from a glass or glass-like material, such as quartz or sapphire. In another embodiment, the substrate is formed from a semiconducting material, such as a silicon material or the like. Although the substrate **100** is illustrated as having a substantially circular shape, it is contemplated that the substrate **100** may be polygonal in shape, such as quadrilateral in shape, for example, rectangular or square shaped.

The substrate **100** is illustrated as having a plurality of dies **104** formed thereon. The dies **104** correspond to areas of the substrate **100** which are patterned with desired structures for subsequent utilization in various devices, such as a computing device, an optical device, or the like. The dies **104** include the microstructures **106** formed thereon. The microstructures **106** are features formed on the dies **104** by various fabrication processes, such as lithography processes, for example, NIL processes. Alternatively, the microstructures **106** are features which are etched or deposited on the substrate **100**. In one embodiment, the microstructures **106** are grating structures and the die **104** is contemplated to be a waveguide or a portion of a waveguide apparatus.

The dies **104** are arranged on the substrate **100** with kerf areas **108** formed around or between adjacent dies **104**. The kerf areas **108** are regions of the substrate surface which are not occupied by the dies **104**. The kerf areas **108** substantially surround each individual die **104** and space individual dies **104** from one another. The kerf areas **108** may also extend between individual dies **104** and a perimeter of the substrate **100**. In one embodiment, the kerf areas **108** have substantially no microstructures or features formed thereon. In various implementations, the kerf areas **108** are regions which are subsequently removed during dicing operations to separate individual dies **104** during singulation.

FIG. 1B illustrates a cross-sectional view of the substrate **100** of FIG. 1A taken along line 1B-1B according to an embodiment described herein. As described above, the kerf areas **108** are regions which are disposed between adjacent dies **104**. It should be noted that the substrate **100** is illustrated as having the microstructures **106** formed on a first side **102** of the substrate **100**. In one embodiment, the microstructures **106** extend a distance of between about 100 um and about 500 um from the first side **102** of the substrate **100**. In one embodiment, the first side **102** is the front side of the substrate **100**. A second side **110** of the substrate **100** exists opposite and parallel to the first side **102**. In the illustrated embodiment, the second side **110** is unprocessed such that no features or microstructures are formed on the second side **110**.

FIG. 2A illustrates a cross-section view of a vacuum chucking apparatus **200** according to an embodiment described herein. The substrate **100** is illustrated as having the first side contacting the vacuum chucking apparatus **200** such that the second side **110** is oriented away from the vacuum chucking apparatus **200** in a position suitable for processing the second side **110**.

The vacuum chucking apparatus **200** includes a body **201** having a chucking surface **202** and a bottom surface **204** oriented opposite to the chucking surface **202**. In one embodiment, the body **201** is formed from a metallic material, such as aluminum, stainless steel, or alloys, combinations, and mixtures thereof. In another embodiment, the body **201** is formed from a ceramic material, such as a silicon nitride material, an aluminum nitride material, an alumina material, or combinations and mixtures thereof. In certain embodiments, a coating is disposed on the chucking surface **202** of the body **201**. The coating, depending upon the desired implementation, is a polymeric material, such as one or more of a polyimide material, a polyamide material, or a polytetrafluoroethylene (PTFE) material.

A plurality of cavities **206** are formed in the body **201**. The cavities **206** are disposed within the body **201** and extend into the body **201** from the chucking surface **202**. The cavities **206** are defined by a bottom surface **203** and sidewalls **205**. A depth of the cavities **206** is between about 100 um and about 1000 um, for example between about 300 um and about 700 um. It is contemplated that the depth of the cavities **206** is sufficient to accommodate the microstructures **106** formed on the substrate **100** such that the microstructures **106** remain out of contact with the body **201** when the substrate **100** is positioned on the vacuum chucking apparatus **200**. In one embodiment, the plurality of cavities **206** are formed in a material layer disposed on the body **201**.

In one embodiment, a shape of the cavities **206** corresponds to a shape of the dies **104**. For example, if the dies **104** are square or rectangular shaped, the shape of the cavities **206** would similarly be square or rectangular in shape. However, it is contemplated that the size of the cavities **206** may be larger or smaller than an area corresponding to the dies **104**.

A plurality of first ports **208** are formed in the body **201** and a plurality of second ports (surface ports) **210** are formed in the chucking surface **202** of the body **201**. Each of the plurality of first ports **208** are in fluid communication with a respective one of the cavities **206**. The plurality of second ports **210** positioned between the cavities **206**. The plurality of second ports **210** are also formed in the chucking surface **202** of the body radially outward of the plurality of cavities **206**. A plurality of first conduits **212** extend from the plurality of first ports **208** and the plurality of second ports **210** through the body **201** to the bottom surface **204**. Each of the first plurality of conduits **212** are coupled to a first vacuum source **214**. Thus, the first vacuum source **214** is in fluid communication with the cavities **206** as well as the chucking surface **202** of the body **201** via the first plurality of conduits **212**.

FIG. 2B is a plan view of the vacuum chucking apparatus **200** of FIG. 2A. In the illustrated embodiment, the plurality of first ports **208** in the cavities **206** as well as the plurality of second ports **210** at the chucking surface **202** are substantially circular in shape. While circular ports may improve the ease of fabrication of the vacuum chucking apparatus **200**, it is contemplated that any port shape may be utilized. Although several second ports **210** are shown distributed across the chucking surface **202** of the body **201**, any number, arrangement, or distribution of second ports **210** suitable to enable substantially flat chucking of the substrate **100** are contemplated to be within the scope of this disclosure.

In operation, vacuum pressure is generated by the first vacuum source **214** to chuck the substrate **100** to the body **201** at regions remote from the cavities **206**. In addition, the vacuum pressure from the first vacuum source **214** is utilized to stabilize the substrate **100** during processing, particularly at areas corresponding to positions of the microstructures **106** on the substrate **100**.

In a lithography process, in particular a SCIL process, a patterned template (patterned from a master pattern) is effectively pressed against a resin layer disposed on the second side **110** of the substrate. For example, the patterned template is provided onto a flexible optically transparent substrate that is pressed at certain intervals and/or pressures against the resin layer on the substrate **100**. It is contemplated that vacuum chucking the substrate **100** to the body **201** is sufficient to achieve desirable substrate flatness for applying the patterned template to the second side **110** of the substrate. After the patterned template is applied to the resin on the second side **110** of the substrate, the resin is cured without removing the patterned template and the flexible optically transparent substrate from the second side **110** of the substrate. However, after curing of the resin, the patterned template and the flexible optically transparent substrate are removed from the second side **110** of the substrate. The patterned template and the flexible optically transparent substrate are effectively peeled off of the cured resin layer on the second side **110** of the substrate, which creates bending moments and/or stresses in the substrate **100**. The removal process is described in more detail in FIGS. **3**A-**3**C.

FIG. **3**A is a schematic sectional view of a portion of a transfer process of a patterned template **300** onto the resin layer **315** of the substrate **100**. The substrate **100** is chucked to a vacuum chucking apparatus **200** as described herein. The patterned template **300** includes a plurality of features **305** coupled to a flexible optically transparent substrate **310**. Each of the plurality of features **305** may be protrusions, depressions, or a combination thereof, which is pressed against a resin layer **315** disposed on the second side **110** of the substrate **100**. The patterned template **300** is applied to the resin layer **315** by a plate **318** having a plurality of variable pressure grooves **320** that incrementally applies positive pressure to the patterned template **300** in order to transfer a pattern of structures **325** in or on the resin layer **315**. For example, the patterned template **300** is incrementally pressured against the resin layer **315** from a first side **327**A of the substrate **100** to an opposing second side **327**B of the substrate **100** by selectively applying pressure from the variable pressure grooves **320** of the plate **318**.

However, during removal of the patterned template **300**, which occurs after the resin layer **315** is cured, the patterned template **300** is peeled away from the resin layer **315** from the second side **327**B of the substrate **100** to the first side **327**A of the substrate **100** by selectively applying vacuum from the variable pressure grooves **320** of the plate **318**. This incremental vacuum application by the plate **318** forms a separation line **330** that moves from the second side **327**B of the substrate **100** to the first side **327**A of the substrate **100** based on the application of vacuum pressure from the variable pressure grooves **320**. The force provided by the variable pressure grooves **320** in pulling the patterned template **300** away from the substrate **100** may dislodge the substrate from the vacuum chucking apparatus **200**. Additionally or alternatively, the force provided by the variable pressure grooves **320** in pulling the patterned template **300** away from the substrate **100** may deform the substrate **100** at the separation line **330**. If deformation of the substrate **100** exceeds a specified value, the microstructures **106** on the first side **102** of the substrate **100** may be damaged. The vacuum chucking apparatus **200** as described herein is utilized to prevent or minimize deformation of the substrate **100** particularly at positions corresponding to the cavities **206**

FIGS. **3**B and **3**C are sectional view of portions of the vacuum chucking apparatus **200** having the substrate **100** thereon. FIGS. **3**B and **3**C show a slight deformation in the substrate **100** during removal of the patterned template **300** of FIG. **3**A based on different positions of the separation line **330** shown in FIG. **3**A. FIG. **3**B shows an active cavity **335**A depicting the substrate **100** in a convex orientation corresponding to pulling of the substrate **100** at the separation line **330**. FIG. **3**C shows an idle cavity **335**B depicting the substrate **100** in a concave orientation due to vacuum application from the first vacuum source **214** through one of the first ports **208** either before or after the separation line **330** has passed thereacross. The active cavity **335**A and the idle cavity **335**B are each one of the cavities **206** shown in FIGS. **2**A and **2**B. In one embodiment, the pressure within each of the active cavity **335**A and the idle cavity **335**B is the same. However, when the separation line **330** is adjacent to the substrate **100**, as described in FIG. **3**B, the force of the variable pressure grooves **320** of the plate **318** overcomes the pressure within the active cavity **335**A.

However, according to embodiments described herein, the degree of deformation, depicted as reference numeral **340**, is kept within specifications utilizing the vacuum chucking apparatus as disclosed herein.

FIG. **4**A illustrates a plan view of the vacuum chucking apparatus **200** of FIG. **2** according to an embodiment described herein. The illustrated second (surface) ports **210** are in an irregularly shaped groove pattern to increase the surface area of the substrate exposed to vacuum relative to the embodiment shown in FIGS. **2**A and **2**B.

FIG. **4**B illustrates a cross-sectional view of the vacuum chucking apparatus **200** of FIG. **4**A. In the illustrated embodiment, the vacuum chucking apparatus **200** includes a second plurality of ports **404**, a second plurality of conduits **402**, and a second vacuum source **406**. The second plurality of ports **404** are formed in the bottom surface **203** of the cavities **206** and the second plurality of conduits **402** extend from each of the second plurality of ports **404** through the body **201** to the bottom surface **204**. The second plurality of conduits **402** are coupled to the second vacuum source **406** accordingly.

In operation, the vacuum chucking apparatus **200** of FIGS. **4**A and **4**B enables differential pressure chucking of the substrate **100**. The first vacuum source **214**, which is in fluid communication with the substrate **100** via the first plurality of conduits **212** and the first plurality of ports **210**, generates a first vacuum pressure to chuck the substrate to the chucking surface **202** of the body **201**. The second vacuum source **406**, which is in fluid communication with the cavities **206** via the second plurality of conduits **402** and the second plurality of ports **404**, generates a second vacuum pressure to further reduce a pressure with the cavities **206** and reduce or eliminate the degree of deformation of the substrate **100**. It is contemplated that the first vacuum pressure may be greater than, less than, or equal to the second vacuum pressure, depending upon desired chucking characteristics. In some implementations, the first vacuum pressure and the second vacuum pressure may be below ambient pressure where the vacuum chucking apparatus **200** is in operation. The ambient pressure may be atmospheric pressure (e.g., at or about 760 millimeters mercury (mmHg)).

FIG. **5**A illustrates a plan view of the vacuum chucking apparatus **200** of FIG. **2** according to an embodiment described herein. FIG. **5**B is a schematic sectional view of the vacuum chucking apparatus **200** along lines **5**B-**5**B of FIG. **5**A. In this embodiment, the vacuum chucking apparatus **200** is provided with multiple pressure zones which includes a first pressure zone **500**A, a second pressure zone **500**B, a third pressure zone **500**C and a fourth pressure zone **500**D. The fourth pressure zone **500**D is defined by a groove pattern **505** that is utilized to chuck portions of a substrate **100** not having microstructures **106** formed thereon. The cavities **206**, shown as cavities **510**A-**510**C, are utilized to chuck portions of the substrate having the microstructures **106** as described above. Each of the cavities **510**A-**510**C are in fluid communication with a first vacuum source **515**A, a second vacuum source **515**B and a third vacuum source **515**C, and the groove pattern **505** is in fluid communication with a fourth vacuum source **515**D. Each of the vacuum sources **515**A-**515**D are independently controlled.

As shown in FIG. **5**B, a plurality of first conduits **520** are coupled to the fourth vacuum source **515**D. A surface opening **525** of each of the plurality of first conduits **520** is in fluid communication with the groove pattern **505** of FIG. **5**A, which is utilized to chuck portions of the substrate **100** that are not disposed over the cavities **510**A-**510**C. A plurality of second conduits **530** are coupled to the cavities **510**A (not shown in the side view of FIG. **5**B) and the first vacuum source **515**A. A plurality of third conduits **535** are coupled to the cavities **510**B and the second vacuum source **515**B. An opening **540** of each of the plurality of third conduits **535** provide negative pressure application to the exposed portions of the substrate **100** in the cavities **510**B. A plurality of fourth conduits **545** are coupled to the cavities **510**C (not shown in the side view of FIG. **5**B) and the third vacuum source **515**C. While not shown in the side view of FIG. **5**B, the plurality of second conduits **530** and the plurality of fourth conduits **545** include openings, similar to the openings **540**, which provide negative pressure application to the exposed portions of the substrate **100** in the cavities **510**A and **510**C, respectively.

Pressure in the fourth pressure zone **500**D may remain constant while the pressure in the first pressure zone **500**A, the second pressure zone **500**B and the third pressure zone **500**C is individually controlled. The pressures in the first pressure zone **500**A, the second pressure zone **500**B and the third pressure zone **500**C may be varied based on the position of the separation line **330**. For example, when the separation line **330** is positioned over the substrate at the locations of the cavities **510**A as shown in the first pressure zone **500**A, pressure is lower in the cavities **510**A as compared to a pressure of the cavities **5106** and **510**C. However, when the separation line **330** moves across the substrate, such as above the cavities **510**B in the second pressure zone **500**B, the pressure of the cavities **510**A and **510**C is higher than a pressure of the cavities **510**B. Similarly, when the separation line **330** is above the cavities **510**C, the pressure is lower in the cavities **510**C as compared to a pressure of the cavities **510**A and **510**B.

FIG. **6** illustrates a sectional view of a portion of a vacuum chucking apparatus **200** according to an embodiment described herein. In this embodiment, a cavity **206** is provided with a support member **600**. The support member **600** is utilized to enable use of lower pressure within the cavity **206** while reducing or eliminating the degree of deformation **340** of the substrate **100**. The support member **600** may be a removable feature or may be formed as a portion of the vacuum chucking apparatus **200**. The support member **600** may be used with certain types of microstructures **106** where contact of the substrate **100** with the support member **600** does not damage the microstructures **106**.

In summation, a substrate chucking apparatus having cavities formed therein enables chucking of substrates with surfaces having microstructures formed thereon for dual sided substrate processing. The chucking apparatus include various vacuum chucking elements as described above that are utilized to reduce or eliminate the degree of deformation **340** of the substrate **100** during processing.

While the foregoing is directed to embodiments of the present disclosure, other and further embodiments of the disclosure may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

What is claimed is:

1. A method for processing a substrate, the method comprising:

positioning a substrate having a first surface on a chuck, the first surface having a plurality of structures formed thereon, wherein each of the plurality of structures are positioned in a respective cavity formed in a chucking surface of the chuck;

applying a first pressure to the first surface through a plurality of ports formed in the chucking surface while applying a second pressure in pairs of the cavities, the first pressure being different than the second pressure; and

forming a plurality of structures on a second surface of the substrate.

2. The method of claim **1**, wherein the cavities include a first pair of cavities and a second pair of cavities.

3. The method of claim **2**, wherein the first pair of cavities is coupled to a first conduit and the second pair of cavities is coupled to a second conduit.

4. The method of claim **3**, wherein the first conduit is coupled to a first vacuum source and the second conduit is coupled to a second vacuum source.

5. The method of claim **1**, wherein each of the plurality of surface ports are in fluid communication with a groove pattern formed in the chucking surface.

6. The method of claim **5**, wherein the groove pattern surrounds a portion of the cavities.

7. The method of claim **1**, wherein the forming the plurality of structures on the second surface comprises:

forming a resin layer on the second surface; and

transferring a pattern from a template onto the resin layer.

8. The method of claim **7**, wherein the template is coupled to a plate by a plurality of variable pressure grooves.

9. The method of claim **8**, further comprising:

removing the template from the resin layer by incrementally applying a negative pressure to the variable pressure grooves.

10. A method for processing a substrate, the method comprising:

positioning a first surface of a substrate having a plurality of structures formed thereon on a chuck, wherein the chuck includes a plurality of cavities formed in a chucking surface of the chuck that corresponds to a pattern of the plurality of structures formed on the substrate;

applying a first pressure to the first surface through a plurality of ports formed in the chucking surface while applying a second pressure in pairs of the cavities, the first pressure being different than the second pressure; and forming a plurality of structures on a second surface of the substrate, wherein the forming the plurality of structures on the second surface comprises:

forming a resin layer on the second surface; and

transferring a pattern from a template onto the resin layer.

11. The method of claim **10**, wherein the template is coupled to a plate by a plurality of variable pressure grooves.

12. The method of claim **11**, further comprising:

removing the template from the resin layer by incrementally applying a negative pressure to the variable pressure grooves while minimizing deformation of the substrate.

13. The method of claim **10**, wherein the cavities include a first pair of cavities and a second pair of cavities.

14. The method of claim **13**, wherein the first pair of cavities is coupled to a first conduit and the second pair of cavities is coupled to a second conduit.

15. The method of claim **14**, wherein the first conduit is coupled to a first vacuum source and the second conduit is coupled to a second vacuum source.

16. A method for processing a substrate, the method comprising:

positioning a first surface of a substrate having a plurality of structures formed thereon on a chuck, wherein the chuck includes a plurality of cavities formed in a chucking surface of the chuck that corresponds to a pattern of the plurality of structures formed on the substrate;

applying a first pressure to the first surface through a plurality of ports formed in the chucking surface while applying a second pressure in pairs of the cavities, the first pressure being different than the second pressure; and

forming a plurality of structures on a second surface of the substrate, wherein the forming the plurality of structures on the second surface comprises:

forming a resin layer on the second surface;

transferring a pattern from a template onto the resin layer; and

removing the template from the resin layer while varying pressures in each of the plurality of cavities.

17. The method of claim **16**, wherein the cavities include a first pair of cavities and a second pair of cavities.

18. The method of claim **17**, wherein the first pair of cavities is coupled to a first conduit and the second pair of cavities is coupled to a second conduit.

19. The method of claim **18**, wherein the first conduit is coupled to a first vacuum source and the second conduit is coupled to a second vacuum source.

20. The method of claim **16**, wherein the template is coupled to a plate by a plurality of variable pressure grooves.

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